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THE TEACHER'S OUTFIT IN PHYSICAL GEOGRAPHY

II.

In this brief outline I would give but one more hint for field and laboratory study of the land. The crust of the earth is composed of minerals, and the combination of these forms rocks. Therefore for any proper study of the surface of the earth, the common minerals and rocks should be known and their characteristics and importance be appreciated. There are now on sale cheap sets of minerals and rocks adapted to this study. Among others there are such sets offered, at very low price, by two well-known dealers, H. A. Ward, Rochester, N. Y., and E. E. Howell, 612 Seventeenth St., N. W., Washington, D. C., from whom information may be obtained concerning cost, etc.

While these sets are of great value, because they are properly identified and labeled, and while I believe that they should be in every school where physical geography and geology are taught, I am firmly of the opinion that more good will come from actually collecting a few specimens than from studying sets. Many schools are situated in the midst of good mineral localities, and near them are ledges of numerous kinds of rocks, in which there are often fossils. Moreover, in the northern states there are many gravel banks of glacial origin within short distances of the school; and these are regular storehouses of rock specimens gathered by the ice from various sources. A teacher who has

never thought of this point will be surprised to find that from these sources may often be gathered specimens of nearly all the common rocks, many of the common minerals and not a few fossils. In botany the student is called upon to make collections of pressed plants; in many localities in this country the same can be done with minerals, rocks and fossils. These should not only be collected and labeled, but they should also be studied, and their importance should be learned by means of collateral reading: for instance, where do they commonly occur? how do they weather? etc.

Having been asked to write especially upon physiography, I do not feel called upon, even if space were available, to consider methods in the study of the air and the ocean. Still, feeling so confident that these subjects should form a part of the general study, I cannot dismiss them entirely. Fortunately I can refer to places where suggestions may be found; and as two of these are writings of my own, it will be as well to refer to them as to attempt briefer statements here. First of all, I would urge that careful attention be given to the suggestions in the report of the Committee of Ten. The geographical report is especially strong and full in its recommendations concerning meteorology. In Bulletin 32 (July 1895) of the regents of the state of New York (which can be obtained from the regents' office at Albany, N. Y.), I have presented some hints (pp. 992-1011) upon laboratory study in physical geography, in which a study of the air and ocean are included. Suggestions of a similar nature will also be found in an appendix to my *Elementary Physical Geography*, Macmillan & Co., N. Y. (pp. 440-452). From an examination of these the teacher will find that laboratory study is also possible in these branches of physical geography.

So, from beginning to end, the new physical geography can be made to impart information, largely by means of individual study, and at times even directly from the thing itself, or, when this is not possible, from some representation of the phenomenon to be studied. I thoroughly believe that one of the strongest points in favor of physical geography in the schools is the

desirable information which it furnishes; but if this were the only end to be gained by its study, I should be glad to see the subject taken from the curriculum. This end of imparting information may be attained not merely as well, but very much better, by the introduction of other than mere text-book work. Of course, the text-book is necessary, even when the teacher is a thorough master of the subject; for the course would be disconnected if there were not a guide always at hand for the students' reference. But the more fully the text-book can be supplemented, or even replaced, by laboratory and field work, the greater will be the benefit derived from the study of physical geography. What these benefits are has been so frequently stated that it would be useless to repeat them here. Every progressive teacher of science knows full well that science must be taught, not as a collection of facts and theories that some one else has worked out, but rather as something which every one can study for himself, making a proper use, to be sure, of the results that have been gained by much study on the part of the great corps of science workers.

Sources of Information.—Any teacher who would succeed well in instructing must know more than is contained in the text-book which is used. If he does not, he must merely content himself with hearing recitations—an all too prevalent method of instruction in geology and physical geography. Unfortunately these are not subjects in which rules concerning the best method to be used can be laid down. The subjects must first be well understood before the teacher can hope to see how he can best make use of those opportunities for laboratory and out-of-door instruction which are available. With this knowledge, and with an interest in the subjects, thoughtful consideration of the possibilities opened by the environment and by the facilities furnished by the school, will show, to any real teacher, so many avenues for success in this class of instruction that the difficulty will soon be, not where to find opportunity, but, rather, how to make use of all that are open, and which lines of work can be omitted with the least injury.

Therefore, since information on the subject-matter seems desirable for the teacher, and since these sources will serve admirably for books of reference and collateral reading on the part of the student, I will point out what seems to me the best available material. In meteorology there is surely no book which is superior to Davis's *Elementary Meteorology* (Ginn & Co., Boston, \$2.70),¹ though for interesting facts concerning the weather of the United States, Greeley's *American Weather* (Dodd, Mead & Co., New York, \$2.50), will be found of value. Russell's *Meteorology* (Macmillan & Co., New York, \$4.00), Scott's *Elementary Meteorology* (Scribner & Co., New York, \$1.75), and Waldo's *Modern Meteorology* (Scribner & Co., New York, \$1.25), are all important books. The daily weather maps should be asked for and also the *Annual Reports* and *Monthly Weather Review*, published by the United States Weather Bureau, Agricultural Department, Washington. It is probable that these can be obtained free of cost.

Unfortunately, the general subject of the ocean is not treated in a really thorough manner in any book. For the American student, the best general treatise on the ocean bottom is Volume I. of Agassiz' *Three Cruises of the Blake* (Houghton, Mifflin & Co., Boston, two volumes, \$8.00). Many of the results of the famous Challenger expedition will be found in Thomson's *The Atlantic*, which is now sold in this country by McDonough, Albany, N. Y., at a greatly reduced price (two volumes \$3.00). Methods of sounding and dredging are described in Sigsbee's *Deep Sea Sounding and Dredging*, which is published by the United States Coast Survey at Washington, and distributed free of cost. The Gulf Stream is well described in Pillsbury's *Gulf Stream*, also published and distributed by the Coast Survey. There is much that is suggestive and interesting in Shaler's *Sea and Land* (Scribner & Co., New York, \$2.50). Tables of the height and time of tides for the Atlantic coast (and also for the Pacific) may be obtained from the United States Coast Survey (25 cents each year).

¹ Reference to other books may be found at the end of the various chapters of my

In geology there is no single treatise that can be read with more pleasure and profit than Lyell's *Principles of Geology* (Appleton & Co., New York, two volumes, \$8.00), which is the great geological classic, and a book written in such a truly literary style that the mere reading is a pleasure. As a book of reference in which the latest knowledge of geology is presented, none is superior to Geikie's *Text-book of Geology* (Macmillan & Co., New York, \$7.50). Dana's *Manual of Geology* (American Book Co., New York, \$5.00) and LeConte's *Elements of Geology* (American Book Co., New York, \$4.00), from some standpoints are better adapted to American readers. From any one of these the teacher can gain stores of information on geological topics. Each one of these authors has published a more elementary and cheaper book on geology,¹ which would perhaps be better for reference books for students, and, indeed, possibly for those teachers who are beginning to train themselves for this work. Another small geology which might well be added to the list is Shaler's *First Book in Geology* (Heath & Co., Boston, \$1.00), which is written in his well-known fascinating style, and in which some subjects are expanded in just the way to interest the beginner. It will be particularly interesting for collateral reading for the students.

In many states there have been geological surveys;² and in the reports which have been published, many teachers will find descriptions of the geology of the region in which they live. It will be impossible to state here just what has been published, but information can easily be obtained from the state capital.

Elementary Physical Geography, published in 1895, by Macmillan & Co., New York (\$1.40). Second, revised edition, 1896.

¹Geikie's *Class Book of Geology*, Macmillan, \$1.10.

Le Conte, *Compend of Geology*, American Book Co., \$1.20.

Dana, *Text-book of Geology*, American Book Co., \$2.00.

Dana, *The Geological Story Briefly Told*, American Book Co., \$1.15.

Also, Winchell, *Geological Studies*, Griggs, Chicago, \$2.50.

²Among others, recently, in New York, New Jersey, Pennsylvania, North Carolina, Georgia, Alabama, Texas, Arkansas, Ohio, Michigan, Minnesota, Missouri, Kansas, Iowa, South Dakota and California. Sometimes good photographs can be obtained from the State Survey.

The national government is also publishing much material each year, and the *Annual Reports of the Geological Survey* are particularly valuable. These may be obtained from the Director of the United States Geological Survey at Washington, and they can often be obtained free of cost by the aid of a Congressman. In addition to these reports, there are other publications by the Survey, the most important of which are the sheets of the Geological Atlas and the topographic maps, both of which are very inexpensive. In many cases the teachers will find their own districts mapped topographically and in some cases even the geological map may be finished. Printed information of the publications and the maps issued by the Survey may be obtained on application. The separate parts of the Geological Atlas furnish many instances of different kinds of rock structure and will be found very useful in school work. They are sold by the Survey at 25 cents each, which represents only the cost of printing. Reference to many of the individual articles in the Survey publications will be found at the end of the various chapters in my *Elementary Physical Geography*.

The Colorado cañon has recently been described by Major Powell in his *Cañons of the Colorado* (Flood & Vincent, Meadville, Pa., \$10.00), and there have been descriptions of this wonderful region in several of the publications of the Geological Survey.

Niagara is beautifully described by Gilbert in the 1890 report of the Smithsonian Institution, which can be obtained from that bureau free. The same author has also described this river in one of the Geographic Monographs, referred to below.

The best publication upon lakes is Russell's *Lakes of North America* (Ginn & Co., Boston, \$1.65). *Lake Bonneville* by Gilbert, and *Lahontan* by Russell, two monographs of the United States Geological Survey, are invaluable, not merely from their discussions of those regions, but also for the light that they throw upon the study of the surface of the land. Particularly is this true of Gilbert's Monograph, which is one of the best publications so far put forth by an American geologist.

Glaciers are well treated in Wright's *Ice Age in North America*

(Appleton & Co., New York, \$5.00) and also in his smaller book, *Man and the Glacial Period*, by the same publishers (\$1.75). There is also a very important English book, Geikie's *The Great Ice Age* (Appleton & Co., New York, \$7.50). Besides these there are several articles on glaciers in the annual reports of the United States Geological Survey.

Coral islands are treated by Dana in his *Corals and Coral Islands* (Dodd, Mead & Co., New York, \$5.00). Volcanoes are described by Dana, *Characteristics of Volcanoes* (Dodd, Mead & Co., New York, \$5.00), Hull, *Volcanoes* (Scribner & Co., New York, \$1.25), and Judd, *Volcanoes* (Appleton & Co., New York, \$2.00). Earthquakes are discussed by Milne in his *Earthquakes* (Appleton & Co., New York, \$1.75). Minerals are well treated in Dana's *Text-book of Mineralogy* (Wiley & Sons, New York, \$3.50).¹ For a scientific treatment of rocks as such see Harker's *Petrology for Students* (Macmillan & Co., New York, \$1.60). Such a statement of palæontology as would be of interest in connection with geology will be found in the text-books of geology, referred to above. From the standpoint of Evolution, William's *Geological Biology* (Holt & Co., New York, \$2.80) is of great value. An admirable little book on Palæontology is Wood's *Elementary Palæontology* (Macmillan & Co., New York, \$1.60).

These books are mainly written without reference to the later developments of physiography and are, for the most part, treatises in pure geology or allied subjects. Real physiographic geology has hardly begun to find a place in the books; but through the intelligent efforts of the National Geographic Society, there has recently begun to appear a series of short monographs on special topics of physiographic interest. The first volume of ten numbers has appeared, and if these prove successful others may follow. These articles are so important for the teacher and the pupils that I refer to them especially. In the order of their publication they are:

¹ For a shorter account see Dana, *Mineralogy and Petrography*, Wiley & Sons, New York, \$2.00; or *Minerals and How to Study Them*, Wiley & Sons, New York, \$1.50. A good recent book on this subject is Moses and Parsons' *Elements of Mineralogy* (Van Nostrand Co., New York) \$2.00.

1	General Physiographic Processes.....	Powell
2	General Physiographic Features.....	Powell
3	Physiographic Regions of the United States.....	Powell
4	Beaches and Tidal Marshes of the Atlantic Coast....	Shaler
5	Present and Extinct Lakes of Nevada.....	Russell
6	Appalachian Mountains—Northern Section.....	Willis
7	Appalachian Mountains—Southern Section.....	Hayes
8	Mount Shasta—a Typical Volcano.....	Diller
9	The New England Plateau.....	Davis
10	Niagara Falls and Its History.....	Gilbert

These are published by the American Book Co. at 20 cents each or \$1.50 for the set. So far as they go, they are the best literature upon physiographic subjects yet published; and they should find a place in the library of every school where physical geography is taught. To them I would add Geikie's *Scenery of Scotland* (Macmillan & Co., \$3.50).

Besides these sources of information, there are also the scientific magazines, in which much fresh material may be found. *Science*, published by Macmillan & Co. (New York), and *Nature*, an English magazine published by the same company, are constantly adding to the knowledge of various branches of science. In *Science*, there are frequent short abstracts by Professor Davis, entitled Current Notes on Physiography. The *American Naturalist*, Philadelphia, and *Popular Science Monthly*, New York, often have articles of interest. Of a more technical nature, are the *American Journal of Science*, New Haven, Conn., *The American Geologist*, Minneapolis, Minn., and the *Journal of Geology*, Chicago, Ill.

For the teacher of physical geography, undoubtedly the most valuable serial is the *National Geographic Magazine*, which is published monthly in Washington. Anyone interested may become a member of the society upon application, the cost of membership being \$2.00 a year, each member receiving a magazine free. In it there are always articles of importance. Of a similar nature, is the *Bulletin of the American Geographic Society*, published quarterly in New York (11 W. Twenty-ninth St.), at the price of \$5.00 a year.

It is, of course, not supposed that many teachers will find it

possible to obtain and read all of the books referred to above, which, however, are merely a few of the more valuable sources of information. The object is to indicate where information on various topics may be found. With the freely growing tendency towards the accumulation of reference libraries in the schools, it will in many cases be possible for the teacher to have some of these books without the necessity of supplying them out of his own small income.

It is certain that no one can teach a subject well unless he can go to the standard sources for additional facts and suggestions; and it is extremely important to teach the pupils how to do this for themselves. There is altogether too little knowledge of how to look for facts on various subjects; and so I believe that stress should be given to this use of books. Many students leave school with the belief that books are made to be learned, and without the knowledge that they can be used for reference and for occasional reading on subjects of interest. So, for various reasons, I urge as one of the most important parts of the teacher's outfit a good reference library which should, by all means, be accessible to the class.

With a good teacher, well trained if possible, certainly one with a live interest in the subject and a desire to do his best, with a good text-book, with books of reference at hand and the list constantly growing larger, and, above all, with laboratory and field methods of study, I feel safe in predicting for physical geography a permanent and steadily increasing importance in the curriculum of the secondary school. It may be rescued from its present perilous position and be made a valuable and indispensable part of the course, crowning the work in geography, which it follows in natural sequence, and thus giving nearly continuous study, along connected lines, from the lower to the higher grades of the common schools, and at the same time furnishing better training for those who will be fortunate enough to pursue the subject further in a college.

R. S. TARR